DEVELOPING A MODEL FOR CRICKET FRONT FOOD COVER DRIVE BASED ON SELECTED KINEMATIC AND ANTHROPOMETRIC VARIABLE

SHORT SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

to

Lakshmibai National Institute of Physical Education
NERC, Guwahati

by

SARIKA KOURAV
Ghy-21

Under the Supervision of
Dr. Satpal Yadav
Assistant Professor, LNIPE

Department of Physical Education

Lakshmibai National Institute of Physical

Education, NERC, Guwahati

DEPARTMENT OF PHYSICAL EDUCATION

Certificate

I hereby declare that the short synopsis "**Developing a Model for Cricket Front Food Cover Drive Based on Selected Kinematic and Anthropometric Variable**" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Physical Education under Department of Physical Education of Lakshmibai National Institute of Physical Education, NERC, Guwahati, during the academic year 2022-2023.

It is bonafied record of original work carried out under the supervision of Dr. Satpal Yadav and has not been submitted in full or part to any other university or institute for a degree or diploma. Further, it is certified that the short synopsis is plagiarism- free and the proof has been submitted.

(Sarika Kourav)
Ghy-21

Dr. Satpal Yadav
Assistant Professor,
LNIPE, Guwahati

(Chairman DRC)

(Director, LNIPE)

ABSTRACT

Sport, as a dynamic and multifaceted domain, not only promotes physical fitness and entertainment but also offers a platform to explore complex human movement through scientific analysis. Among the various scientific approaches, biomechanics plays a pivotal role in evaluating and enhancing athletic performance by examining the forces and motions that influence human movement. In cricket, one of the most technically demanding and aesthetically appreciated batting techniques is the front foot cover drive. This study aims to develop a predictive model for the front foot cover drive among senior state-level women cricketers using selected kinematic and anthropometric variables. The research focuses on identifying the relationship between linear and angular kinematic variables, along with anthropometric measures, and their influence on the execution quality of the cover drive.

The study is delimited to 15 right-handed female cricketers from Madhya Pradesh, aged between 18 to 25 years, each with a minimum training age of three years. Biomechanical data were collected using 2D motion analysis in four phases of the shot: back lift, foot placement, contact, and follow-through. Variables analyzed included joint angles (ankle, knee, hip, shoulder, elbow, and wrist), height of the center of gravity, and anthropometric measurements such as height, weight, arm and leg lengths. Videographic data were captured and analyzed using Kinovea software, with performance scores assigned by expert judges. The most accurate trial out of five was used for analysis.

Statistical tools such as mean, standard deviation, and regression analysis via SPSS were used to determine the predictive validity of the selected variables. The findings are expected to contribute toward creating a biomechanical model that can aid in skill refinement, injury prevention, and overall performance enhancement in women's cricket. The integration of biomechanics with skill acquisition theories is emphasized to promote a holistic understanding of cricket batting mechanics.

Keyword: Sports Biomechanic, Kinematics, Anthropometric, Cricket Batting Technique, Cover Drive, etc.

LIST OF TABLES

Chapter: **Page no.**

I. Introduction **2-10**

- Statement of the Problem
- Research questions
- Delimitation
- Hypothesis
- Definition and explanation of terms
- Significance of the study

II. REVIEW OF RELATED LITERATURE **11-16**

III. PROCEDURE **16-20**

- Selection of subjects
- Selection of variables
- Criterion measures
- Reliability of Data
- Experimental design
- Procedure for collection of data
- Statistical procedure

BIBLIOGRAPHY **21-23**

Chapter I

INTRODUCTION

Sport includes all forms of competitive physical activity or games which, through casual or organized participation, at least in part aim to use, maintain or improve physical ability and skills while providing enjoyment to participants, and in some cases, entertainment for spectators. Sports can bring positive results to one's physical health. Hundreds of sports exist, from those between single contestants, through to those with hundreds of simultaneous participants, either in teams or competing as individuals ("Sport", 2020).

Mechanics is a branch of science that deals with forces and the effects produced by these forces. The application of this science to biological system is referred to as biomechanics. Human biomechanics focus on how forces act on the musculoskeletal system and how the body tissue responds to these forces (“Malik”, 2015). Using the forces involve in the production of movement and posture. The biomechanics can be discussed in the context of either external or internal biomechanics (“McGinnis”, 2013). External biomechanics describes external forces on body segment and their effect on body movement, while internal biomechanics are forces generated by the body tissues and their effect on movement (“Physiopedia”, 2020).

Biomechanics consists of the study of body movements in sport and exercise, including the relationship between the participant, sports equipment and the exercise environment. Athletes with minor injuries are constantly looking to find ways to get quicker, higher and stronger. Improving your biomechanics could be an important way to improve your athletic performance, minimize injuries and, in turn, promote longevity in your career (Karanja, 2013).

Sports biomechanics is a quantitative-based study and analysis of professional athletes and sports activities in general (Haarer, 1989).

Sports biomechanics is one of the fundamental disciplines in the larger field of sports science. The area incorporates the detailed analysis of the fundamental movements in sport with the aim of reducing injury risk and improving sports performance. Researchers looking at the physical aspects of performance use sports biomechanics analysis to try to understand the relationship between kinetics and physical performance. Biomechanical analysis can have a huge impact on performance by creating models for optimal movement and load analysis. This is used

to determine the safest or most efficient way to move or perform a skill, and investigate the impact a different environment can have on how the body moves or reacts ("Sports Biomechanics - IMeasureU | Leading Wearable Sports Sensors", 2020)

Research on sports biomechanics is traditionally divided into the study of kinetics and kinematics. Kinetics is the study of the relationships between the forces acting on the body and how those forces affect motion. Kinematics is the geometry of the motion of objects which includes displacement, velocity and acceleration. In simple terms, kinetics studies the forces that cause motion (gravity, friction, etc.) while kinematics describes the motion itself (velocity, acceleration, etc.)

The role of biomechanics in physical education and sports helps to enhance techniques using the different creative techniques of biomechanical principles in exercise and sports helps improve the identification of various mistakes, enhances skills, develops and strengthens qualitative and quantitative research with correct and chosen methods and equipment styles. This can be enhanced with many models of scientific quantitative analysis, such as force- motion, force-time, inertia, acceleration, agility, spectrum, segmental interaction and player balance efficiency in terms of speed, time, and accuracy in sport. (Dutt, 2018)

Biomechanical analysis is the assessment of a process, whether in sports, business or in daily life. Analytical approaches used in biomechanics range from those involving costly and sophisticated equipment to techniques that require nothing more than an acute eye and an understanding of movement mechanics (Adrian and Cooper, 2005; Marshall and Elliot, 2005). The goal of sport biomechanics is to provide coaches and athletes with knowledge on sporting skills that will help them achieve the highest level of athletic performance (Smith, 2003). However, according to Glazier et a1. (2003), many prominent researchers are concerned, for quite often now, that biomechanical research and, more specifically, sports biomechanics research, need to shift from its descriptive phase to a more analytical level. (Baumann, 2007; Norman, 2009; Nigg, 2003); therefore, the need to use any possible means to better evaluate skills and movements using methods and materials to enhance performance. There is a need for cooperation between the coach and bio mechanists at every stage of movement research, if the optimum efficiency is to be achieved. Quantitative movement assessment involves the compilation of a permanent record for a variety of studies, so that each can be evaluated and

analyzed. Permanent data logging on movements can take several forms; For example, cinematography, videography, electromyography (EMG), accelerometry, dynamometry, electro-goniometry may not be available for general use. (Adrian, 2003; Marshall and Elliot, 2005).

Technical analysis' is the term given to an empirical approach that is used to understand how sporting skills are practiced and provide the basis for better success through this understanding. This is used mainly in the teaching and coaching of athletic skills and in the head of biomechanics for sport, although it is equally relevant in the clinical setting. Technical analyzes are carried out for several years. Nevertheless, its evolution into a systematic process that integrates scientific principles and methods is recorded from only about half a century ago with the publication of texts that connect scientific principles with coaching practice (e.g. Bunn, 1955; Wells, 1966). Until then, many advances in the study of strategies have been influenced by the diverse desires and needs of students, coaches and scientists. Although technique analysis has been described by authors of biomechanical texts in varying detail, no attempt has been made to review the background and developments of the method or to evaluate its current standing and assess its future potential. With the rapid technological developments in sport science and practice, and the ever-increasing demands for sporting success, such a review is timely. The importance of 'technical analysis' within 'performance analysis' broader scope is dealt with by Hughes and Bartlett (2002, this issue).

Technical research is related to performance changes, but this requires at least two more steps. One is the evaluation or detection of performance faults and the other is the remediation or intervention phase to obtain the desired result (e.g., McPherson, 1990; Knudson and Morrison, 1997; Elliott, 1999). Since quantitative methods of research have evolved and become more commonly accessible, it has become possible to quantify certain aspects of technologically relevant abilities, including using both kinematic and temporal variables. This methodology has come to be called quantitative analysis. Quantitative research provides a particular challenge for the scientist and coach, as the analytical techniques result in the calculation of small data, which must then be 'processed' in a way that represents the basic characteristics of the technique. The time-consuming nature of quantitative analysis has impacted its applicability in an applied environment, where the attention stays on the entire movement. Quantitative analysis has developed into a powerful method for promoting clinical decision-making in a clinical

environment (e.g. gait analysis), but this progress is not yet evident in sports training. More recently, the advancement of mathematical modeling and computer simulation of performance abilities has benefited from the study of techniques. Several researchers have developed multi-linked device models that depict the human body in varying detail. To answer conceptual questions, these models can be used to generate dynamic simulations of a movement and alter input and control conditions. This has been termed predictive analysis (Elliott, 1999), an approach to technique analysis that offers great potential. While it is still in its infancy, it provides the means to achieve one of the theoretical aims of scientific science, that of learning 'the most efficient way of producing movements'. While advanced in its development, it has the benefit of focusing directly on the technique used and can provide a direct visual communication system between the scientist and the coach or athlete, with graphical facilities for human body animation being increasingly available.

Cricket is a bat-and-ball game played between two teams of eleven players on a field at the Center of which is a 22-yard (20-metre) pitch with a wicket at each end, each comprising two bails balanced on three stumps. The batting side scores runs by striking the ball bowled at the wicket with the bat (and running between the wickets), while the bowling and fielding side tries to prevent this (by preventing the ball from leaving the field, and getting the ball to either wicket) and dismiss each batter (so they are "out"). Means of dismissal include being bowled, when the ball hits the stumps and dislodges the bails, and by the fielding side either catching the ball after it is hit by the bat, but before it hits the ground, or hitting a wicket with the ball before a batter can cross the crease in front of the wicket (Wikipedia contributors, 2020).

In cricket, batting is the act or skill of hitting the ball with a bat to score runs or prevent the loss of one's wicket. Any player who is currently batting is denoted as a batsman, batswoman, or batter, regardless of whether batting is their particular area of expertise. Batting players have to adapt to various conditions when playing on different cricket pitches, especially in different countries - therefore, as well as having outstanding physical batting skills, top-level batters will have lightning reflexes, excellent decision-making and be good strategists (Wikipedia contributors, 2020).

A Drive is one of the most common shots of a batsman and is often the first shot that is taught to cricketers starting out. A drive is again a straight-batted shot executed by swinging the bat in a vertical arc through the line of the ball. Depending on the direction in which the ball

moves, a drive can be a cover drive, straight drive or a square drive. There also exists a "midwicket drive" that is played towards a midwicket. Drives can be played both of the front and the back foot ("Cricket Batting Techniques and Tips - Advanced Cricketing Shots Explained", 2020).

The cover drive is an attacking shot that can be played on the front or the back foot, and it is most effective when it is played against deliveries that just outside the line of off stump. This line is often referred to as a 4th, 5th or 6th stump line. The choice of whether to play a front foot cover drive or a back foot cover drive depends on the length of the ball that you receive. Deliveries that are 'back of a length', will require you to play off the back foot. Deliveries that bounce a lot closer to you (referred to as full length deliveries) will require you to step forward and play the front foot cover drive ("Cricket Batting Techniques and Tips - Advanced Cricketing Shots Explained", 2020).

Kinematic gait analysis is the study of the motion of the body, limbs, and joints that occurs during movement. This method of analysis provides a non-invasive means of collecting objective information on joint and limb motion from patients.

Biomechanics and skill acquisition disciplines are complementary and holistic research approach to understanding cricket batting skill. Skill acquisition-motor control specialists are typically grounded in one and more of the theoretical foundation of expertise, that of neuro- motor control or behavioral learning, both of which are fundamental to the assessment of skill and development. A sports biomechanics' training is centered on the physical properties and consequences (e.g. injury and performance) governing human movement; inherent in this training is an emphasis on measurement accuracy. It is apparent that these disciplines clearly complement each other, through there seems to be little recognition of this in the domain of cricket batting research (Portus et al. 2011).

Statement of the problem

The researcher wants to attempt to develop a model for cricket front food cover drive on the basis of selected kinematic and anthropometric variable.

Research questions

1. Is there any prediction of selected linear kinematics variables with the performance of cricket players in front food cover drive shot?
2. Is there any prediction of selected angular kinematics variables with the performance of cricket players in front food cover drive shot?
3. Is there any prediction of anthropometric variable with the performance of cricket player in front food cover drive shot?

Hypotheses

Based on expert opinion, reviews and scholar own understanding of the problem & research findings: -

1. It is hypothesized that there will be significant relationship of selected linear kinematics variables with the performance of cricket players in front food cover drive shot.
2. It is hypothesized that there will be significant relationship of selected angular kinematics variables with the performance of cricket players in front foot cover drive shot.
3. It is hypothesized that there will be significant relationship of selected anthropometric variables with the accuracy of cricket players in cover drive shot.

Delimitations

1. The study will be delimited to Senior State Level Women's Cricketers from M.P.
2. The study will be delimited to the 15 subjects belonging to the age group 18 to 25 years.
3. The study will be delimited to the selected Cricket Technique is front food Cover Drive Shot.
4. The study will be delimited to right-handed batsmen only.
5. The study will be delimited to 2-D motion analysis in four different phases which are as follows:
   a) Back lift during execution
   b) Placement of the foot
   c) Execution (contact)
   d) Follow throw

6. The study will be further delimited to the following selected kinematic and anthropometric variables: -

a) Linear kinematics variables: -

1. Height of centre of gravity at selected moments.

b) Angular Kinematics Variables: -

Angles at

a) Ankle joint
b) Knee joint
c) Hip joint
d) Shoulder joint
e) Elbow joint
f) Wrist joint

c) **Anthropometric variables**

i) Height
ii) Weight
iii) Arm length (Upper & Lower)
iv) Leg length (Upper & Lower)

Definition and Explanation of the Terms

Biomechanics:

Biomechanics in sport incorporates a detailed analysis of sport movements in order to minimize the risk of injury and improve sports performance. Sport and exercise biomechanics encompass the area of science concerned with the analysis of the mechanics of human movement (Hall SJ, 2019).

Kinematics:

Kinematic analysis of movement involves the measurement of position, velocity, and acceleration of one or more body parts. Linear measurements of specific parts, angular

measurements at joints, or a combination can be performed in order to quantify the special and temporal properties of movements of multiple body parts simultaneously.

Linear Kinematics:

Linear kinematics as such deals with the linear motion without taking into account the cause of the motion.

Angular Kinematics:

Angular Kinematics deals with the rotation or the angular motion however; it does not study the cause of angular motion.

Anthropometric Measurement:

Anthropometric measurement refers to the measurement of the human individual. Anthropometric involves the systematic measurement of the physical properties of the human body, primarily dimensional descriptors of the body size and shape.

Center of Gravity:

The center of gravity (CG) of an object is the point at which weight is evenly dispersed and all sides are in balance. A human's center of gravity can change as he takes on different positions, but in many other objects, it's a fixed location.

Cricket:

Cricket is a bat-and-ball game played between two teams of eleven players on a field at the center of which is a 22-yard (20-metre) pitch with a wicket at each end, each comprising two bails balanced on three stumps. The batting side scores runs by striking the ball bowled at the wicket with the bat (and running between the wickets), while the bowling and fielding side tries to prevent this (by preventing the ball from leaving the field, and getting the ball to either wicket) and dismiss each batter (so they are "out"). Means of dismissal include being bowled, when the ball hits the stumps and dislodges the bails, and by the fielding side either catching the ball after it is hit by the bat, but before it hits the ground, or hitting a wicket with the ball before a batter can cross the crease in front of the wicket.

Cover Drive Shot:

The cover drive in cricket is the act of stroking the ball through the covers with well-timed wristwork and conventional movement of the front foot toward the pitch of a delivery aimed at or outside the off stump. The cover drive is considered one of the most graceful shots playable in the sport (Nicholas Hogg).

Significance of the Study

1. The study may provide accuracy in particular shot with respect to angle of approach and also disclose the mechanical aspect of entire movement pattern.
2. Players, coaches and experts of cricket may be greatly benefited with the feedback provided to them regarding their appropriate execution of following movement.
3. The result may be helpful in preparing a technique model of cover drive shot.
4. The finding of present study determined contributing factor to the performance of cover drive shot in cricket.
5. The results of this study may reflect the most significant anthropometric variable affecting the technique of cover drive shot.
6. The study will help the players to improve the accuracy in cover drive shot.
7. The finding of the study may also help the coaches to identify errors in cover drive shot of cricket players.
8. The result may be helpful in preparing a technique of different drive shot of cricket players
9. The results of this study may reflect the most relative variable affecting the performance of cover drive shot.
10. The study may be undertaken to analysis others elements in particular shot of players.

Chapter II
Review of Related Literature

The research scholar has attempted to locate some of the literature related to the study. The relevant literature found from various sources are cited below-

Noorbhai, (2020) was analyzed to discuss the biomechanical implications of the batting backlift technique (BBT) in cricket. Studies were cross-sectional in which both observational and analytical research methods were employed among past and present successful cricketers (n = 299). Biomechanical and video analyses were performed on all participant groups to determine the type of BBT that they performed. The analyses were conducted utilizing the Kinovea TM (Version 0.8.15) software package. This paper showed that the lateral batting backlift technique (LBBT) is a likely contributing factor to successful batsmanship at all levels of cricket ability (junior, adolescent, semi-professional, professional, international and former elite/successful cricketers). It was also found that if batsmen want to be successful at the highest level of cricket, a LBBT is a successful contributing factor (among many of the other contributing factors for success in cricket batting) if adopted at the elite level. Furthermore, the LBBT can assist batsmen in improved performances over the varied formats of cricket between Tests, ODIs and T20s. Despite promising results, there is still a need to answer several questions through further in- depth biomechanical investigations and through interventions that are more counter-intuitive.

Tahir Nazeer et al., (2020), The batting performance is assessed by considering the batting average and strike rate of a batsman. With the induction of T-20 cricket matches, the strike rate of a batsman has gained much attention from coaches and team management. To increase the strike rate a batsman is required to hit powerful shots for boundaries, which assist in making maximum scores at the minimum ball. Therefore, this investigation was planned to determine the effect of body size on the batting performance of cricket batsmen. The literature for this study was selected for cricket coaching manual, cricket books, cricket batting videos, a biography of cricket batsmen, research articles. The academic documents were downloaded and shortlisted from Google Scholar, Research Gate, EBSCO, and ProQuest from 1990 to 2019. The synthesized literature review concludes stature, longer legs, longer arms, and lean body mass of a batsman show positive effects on the execution of powerful shots in cricket. Furthermore, the

maximum strength of muscles assists a batsman to boost up the initial velocity of bat swing to accomplish the ball speed for a successful and powerful shot. Although stature and longer limbs of batsmen are associated with batting performance. On the other hand, the specific training would also enhance the capacity of cricket batsmen for powerful shots in cricket. A future study was proposed to investigate the effect of training on batting performance.

Thander (2019) The purpose of the study was to determine the relationship between selected kinematic variables of bat-lift and batting technique in Front foot straight drive. Five (N=5) male cricket players who represented Visva-Bharati University, WB, were selected as subjects for the study. The videography technique was used to film the subjects in the frontal plane of the bat-lift. The joint point method was used to obtain the values of selected angular kinematic variables from developed stick figures with the help of Kinovea software. The performance in batting was recorded by the scores in front foot straight drives, which was obtained by using a Five Point scale by three judges. To determine the degree of relationship between selected kinematic variables with the batting performance in front foot straight drive, Pearson's Product Moment Correlation method was used. The results have shown the significant values of coefficient of correlation of right hip joint and left hip joint of the selected kinematic variables.

Yadav and Pal (2018), some people are born sports players and some aren't and no amount of science will turn a clumsy person into a world class athlete. Many sporting stars understand instinctively how to be the best in their field—and that built-in understanding, gained through years of practice by trial and error, can achieve the same or better results as a theoretical, scientific approach and by totally different means by understanding few kinematics variables for better performance with utilizing less energy or effort in any field of sports so right from the existence of physical education and sports, all the individuals are always interested in enhancing their performance hence today, physical education teachers, coaches and physical trainers are concerned with helping individuals to learn how to move efficiently and effectively. Biomechanics is a sub-discipline of physical education which further has kinematic as one of its branch. The primary purpose of sports biomechanics is to evaluate a living organism’s motion as well as its application of force. It applies the laws of mechanics and physics to study the bodily movements and the causes of movement both internally and externally. The purpose of this study

was to investigate the cover drive shot and forward defense stroke in young cricketers with the help of selected kinematic variables. This study may be helpful to the coaches and trainees to understand the weakness or flaws in the technique by watching the cinematographic analysis of cover drive shot and forward defense stroke. The present study was delimited to angular kinematic variable (angle at knee, trunk & elbow joint), linear kinematic variable (center of gravity), and height of back lift. The slow motion effect also adds grace to the knowledge of movement of various body parts and help to understand early or late reaction during anticipation of ball or shot. The video was shot in two planes in slow motion format at 240 fps.

Dhake Pratibha, (2017), the purpose of this study was to measure the relationship of selected biomechanical variables to the performance of cricket player in cover drive shot. The subjects for this study were twelve male cricket players of North Maharashtra University Jalgaon, who represented North Maharashtra University Jalgaon, in Inter University Championship. The age ranged from seventeen to twenty five years. All the subjects were right handed batsman. The data was analyzed by use of Pearson's Product Moment Correlation. The level of significance chosen to test the hypothesis was .05. None of the selected angular biomechanical (kinematic) variables that is Ankle Joint (Right and Left), Knee Joint (Right and Left), Shoulder Joint (Right and Left), Elbow Joint (Right and Left) and Wrist (Right and Left), and Hip Joint (Left and Right) has significant relationship with the performance of Cricket players in cover drive shot. In case of Linear A biomechanical (kinematic) variable that is height of center of gravity at moment contact does not have significant relationship with the performance of Cricket players in cover drive shot.

Kumar, (2017) the purpose of this study was to measure the relationship of selected biomechanical variables to the performance of cricket player in cover drive shot. The subjects for this study were twelve male cricket players of Uttarakhand Under-19 Team. All the subjects were right handed batsman. The data was analyzed by use of Pearson's Product Moment Correlation. The level of significance chosen to test the hypothesis was .05. None of the selected angular kinematic variables that is Ankle Joint (Right and Left), Knee Joint (Right and Left), Shoulder Joint (Right and Left), Elbow Joint (Right and Left) and Wrist (Right and Left), and Hip Joint (Left and Right) has significant relationship with the performance of Cricket players in cover drive shot. In case of Linear A biomechanical (kinematic) variable that is height of center

of gravity at moment contact does not have significant relationship with the performance of Cricket players in cover drive shot.

Raza (2016), the study was concluded in order to determine the relationship between selected biomechanical variables with the performance of Pull shot performance in cricket. Twenty male cricket players who had participated in the Inter-University Cricket tournament or any National level tournament were selected as subjects for this study were selected as subjected for the study. The help of digital photography was used to film the subjects is sagital & frontal plane of Pull shot performance. Joint point method was used in order to obtain the values of selected angular kinematics variables from develop stick figures. The performance in Pull shot performance was recorded on the basis of the three judge's evaluation the technique of the subjects on selected batting skills were collected. Ten points scale was used. For each batsman's the average of three judges was considered as the final score. It is hypothesized that there would be no significant relationship between linear & angular kinematic variables and the performance in Batting skills. To determine the degree of relationship between selected biomechanical variables with the performance in Pull shot performance Pearson's product Moment Correlation Method, Multiple correlation & regression equation was used. A significant relationship between (Pull shot performance at moment execution) and ankle joint (right), knee joint (right) & shoulder joint (left) as the correlation coefficient values were found higher than the tabulated value at .05 level of significance. A significant relationship between (Pull shot performance at moment execution) and shoulder joint(right),shoulder joint(left) & elbow joint(left) as the correlation coefficient values were found higher than the tabulated value at .05 level of significance. Since the researcher has calculated the relationship individually. This may be attributed to the fact that the angles at different joints mentioned in this study such as Knee joint, Ankle joint, Hip joint, Shoulder joint, Elbow joint. Change from one individual to another according to his Anthropometric measurement i.e. his height, leg length, arm length.

Kumar, P., & Singh, R. (2014), the purpose of this study was to measure the relationship of selected biomechanical variables to the performance of cricket player in cover drive shot. The subjects for this study were twelve male cricket players of Delhi University, who represented Delhi University, in Interuniversity Championship. The age ranged from seventeen to twenty two years. All the subjects were right handed batsman. The data was analyzed with the help of

Pearson's Product Moment Correlation. The level of significance chosen to test the hypothesis was at .05. The values of coefficient of correlation in case of all the selected Kinematic variables were found insignificant at selected level of significance of 0.05. Result also shows that height of center of gravity at the selected moment has shown insignificant negative relationship with the performance of Cricket players in cover drive shots. None of the selected angular biomechanical (kinematic) variables that is Ankle Joint (Right and Left), Knee Joint (Right and Left), Shoulder Joint (Right and Left), Elbow Joint (Right and Left) and Wrist (Right and Left), and Hip Joint (Left and Right) has significant relationship with the performance of Cricket players in cover drive shot. In case of Linear a biomechanical (kinematic) variable that is height of center of gravity at moment contact does not have significant relationship with the performance of Cricket players in cover drive shot.

Portus Marc R. & Farrow Damian (2011), this review synthesizes the biomechanical and skill acquisition/sport expertise literature focused on the skill of cricket batting. The literature is briefly reviewed and the major limitations, challenges, and suggested future research directions are outlined. This is designed to stimulate researchers to enhance the understanding of cricket batting biomechanics and skill acquisition and in turn assist cricket coaches develop efficacious batting skill development programmes. An interdisciplinary approach between biomechanists and skill acquisition specialists is advocated to further knowledge of the underlying processes and mechanisms of cricket batting expertise. Issues such as skill measurement, practice design, ball machines, skill transfer, and the impact of Twenty/20 cricket, video simulation, and skill decomposition are discussed. The Pro Batter™ ball machine systems are introduced along with suggestions for best practice approaches for coaches when designing batting skill development programmes.

Stretch et al., (2001), in this review, we critically evaluate the scientific research into the morphology and physiology of cricket batsmen. We consider all aspects of the motor control of this skill, in the context of research into dynamic interceptive actions, the biomechanics (kinematics and kinetics) of the various phases of batting strokes and injuries to batsmen. Some attention is also devoted to batting equipment and to psychological factors in batting. Because of the lack of published scientific research into women's cricket, this review focuses on the men's game and covers research on batsmen of various playing standards. For the future, we see as a

high priority research into injury mechanisms, rather than simple injury statistics, and the role of cricket equipment design in injury prevention. A second priority is for multi- or inter-disciplinary research, linking the biomechanics of batting to the underlying motor control of the movements and the effect of environmental information. Biomechanical studies of the variability of the batsman's movements are needed, and these should be related to the compensatory variability proposal of ecological psychology. Clearly, there is also a need for scientific research into batting in women's cricket, which has been inadequately researched to date.

Chapter III

Procedure

In this chapter the selection of the subjects, selection of variables, criterion measures, reliability of data, procedure for collection of data and the statistical techniques employed for analysis will be described.

Selection of the subjects

For the purpose of this study, 15 Senior State level Cricket Players from M.P., age ranging between 18 to 25 years will be selected by using convenient purposive sampling technique. The training age of the subjects will be of minimum 3 years. Subjects will provide written, voluntary, informed consent prior to participation. All will be regular players with efficient skill level. The purpose of the research was explained to all the subjects and subjects were motivated to put their best during each trial.

Selection of variables

On the basis of review of literature, expert's opinion, facilities & instruments availability and scholars own understanding of the problem various kinematics variables of cover drive shot will be selected.

Independent variable

A. Linear kinematic variables:

1. Height of centre of gravity at selected moments.
    - i) Back lift during execution
    - ii) Placement of the foot
    - iii) Execution (contact)
    - iv) Follow throw

B. Angular kinematic variables- angles at:

1. Ankle Joint
2. Knee Joint
3. Hip Joint
4. Shoulder Joint
5. Elbow Joint
6. Wrist Joint

c. Anthropometric variables;

1. Height
2. Weight
3. Arm length
4. Leg length

Dependent variables

The accuracy of cover drive shot will be taken as the performance factor.

Criterion Measures

For the purpose of present study, the technique of cover drive shot in batting of each selected subjects will be taken as the criterion measures. The technique will be recorded on the basis of certain criteria (point system). It will be divided into components (1. back lift 2. footwork, 3. downswing and impact 4. Follow throw), each consist of maximum 10 points. The angles at selected joints and center of gravity of selected subject will be recorded by the kinovea software. And anthropometric measurement will be recorded by anthropometric measurement tool kit (height by stadiometer, weight by weighing machine, and arm and leg length by measuring tapes)

Reliability of data

The reliability of data will be established by instrument reliability. Standard and calibrated equipment like camera, bowling machine etc. will be used. All the measurements pertaining to the selected kinematic variables will be taken by the research scholar under the expert's guidance, so the data collection for the present study will be considered to be reliable.

Procedure for Collection of Data

The technique of the subjects, filming protocol and analysis obtained are described as under:

Technique of the subjects

Total 15 right-handed batsman will be chosen for the purpose of the study, technique of the subjects on Cover drive shot in batting will be collected on the basis of the judge evaluation. The averages of three judges will be considered as the final points obtained by each batsman. Each batsman will play five legal deliveries, each of the delivery will assign ten marks. The standard cricket ball will be used for the purpose of the study.

Filming protocol

Videography technique will be employed for the biomechanical analysis of Cover drive shot technique in batting. For obtaining individual photographic sequence, the subjects will be recorded in a controlled condition with the help videography technique. Four moments will be selected for the analysis i.e., back-lift, placement of the foot, contact and follow-through. On the basis of sequence photographs taken from the video, the scholar developed stick figures from which selected biomechanical variables will be calculated. The stick figures will be developed by using kinovea software. The subjects will get 5 trails to perform the technique and the best trail will be used for the analysis.

Analysis of the film and Collection of data

After video recording, the video will be played with the help of computer and final position of each selected different moment will be obtained on the screen and kept in pause. Further the stick figures of all the moments of cover drive shot i.e. (1) back lift, (2) placement of the foot, (3) Contact point, (4) follow throw converted into photographs & recorded and saved for all selected subjects. The center of gravity and kinematics variables of each subject's will be determined by the Kinovea software.

Statistical technique

SPSS software will be used for all statistical calculation. Mean, standard deviation, standard error of mean, kurtosis, skewness will be based as description statistics and for predicting the contributing kinematic factors of cover drive for accuracy at each phase, multiple regression model will be use at 0.05 level of significance

References

Adrian, M.J. and Cooper, J.M. (2005). Biomechanics of Sports (2nd ed). Missouri; McGraw-Hill.

Baumann, W. (2007). Biomechanics of sports: Current problems. In: Bargmann G. et al. (eds) Biomechanics: Basic arid applied research 51-58. Lancaster; Academic Publishers.

Bunn, J.W. (1955). Scienti®c Principles of Coaching. Englewood Cliþs, NJ: Prentice-Hall.

Cricket Batting Techniques and Tips - Advanced Cricketing Shots Explained. Blog.decathlon.in. (2020). Retrieved 23 December 2020, from https://blog.decathlon.in/articles/cricket-batting-techniques-and-tips-advanced-cricketing-shots-explained.

Cricket Batting Techniques and Tips - Advanced Cricketing Shots Explained. Blog.decathlon.in. (2020). Retrieved 23 December 2020, from https://blog.decathlon.in/articles/cricket-batting-techniques-and-tips-advanced-cricketing-shots-explained.

Dhake, P. (2017). Relationship of selected biomechanical variables with the performance of cricket players in cover drive shot. *International Journal Of Yogic, Human Movement And Sports Sciences*, *2*(2), 71-73. Retrieved 24 December 2020, from https://www.theyogicjournal.com/pdf/2017/vol2issue2/PartB/2-2-4-313.pdf.

Dutt, S. (2018). Role of Biomechanic in Physical Education and Sports. Retrieved from http://www.nationaljournals.com/archives/2018/vol3/issue1/3-1-338

Elliott, B. (1999). Training in Sport. Chicester: Wiley

Elliott, B.C., Baxter, K.G. and Beiser, T.F. (1999). Internal rotation of the upper-arm segment during a stretch-cycle movement. Journal of Applied Biomechanics, 15, 381±395.

Glazier, P.S, Davids K. and Bartlett R.M. (2003).Grip force dynamics in cricket batting. In: Davicis K. et al. (eds) Interceptive Actions in Sport: Information and movement (311- 225) London; Taylor and Frances.

Haarer, D. (1989). Lasertechnik. Grundlagen, eigenschaften, anwendung. VDI-Verlag, Düsseldorf 1989. DM 68. - ISBN 3-18-400879-0 (German language video cassette, 17 min.). *Advanced Materials*, *1*(12), 460-461. doi: 10.1002/adma.19890011215

Hall SJ. What Is Biomechanics? In: Hall SJ. eds. Basic Biomechanics, 8e New York, NY: McGraw-Hill; 2019.

http://accessphysiotherapy.mhmedical.com/content.aspx?bookid=2433&sectionid=1915089

67. (last accessed June 03, 2019)

Hughes, M.D. and Bartlett, R.M. (2002). The use of performance indicators in performance analysis. Journal of Sports Sciences, 20, 739±754.

Introduction to Human Biomechanics 1. (2020, October 10). *Physiopedia,*. Retrieved 18:16, December 17, 2020 from https://www.physiopedia.com/index.php?title=Introduction_to_Human_Biomechanics_1&oldid=253499

Karanja, J. (2013). The importance of proper biomechanics. Retrieved from http://sircsportresearch.blogspot.com/2013/08/the-importance-of-proper-biomechanics.html?m=1

Kumar, P., 2017. Relationship of selected kinematic variables with the performance of cricket players in cover drive shot Uttarakhand under-19 team. *International Journal of Physical Education, Sports and Health 2017; 4(4): 218-220,* Available at: <https://www.kheljournal.com/archives/2017/vol4issue4/PartD/4-4-27-977.pdf> [Accessed 25 December 2020].

Kumar, P., & Singh, R. (2014). Relationship of Selected Biomechanical Variables with The Performance of Cricket Players in Cover Drive Shot.

Knudson, D.V. and Morrison, C.S. (1997). Qualitative Analysis of Human Movement. Champaign, IL: Human Kinetics

McGinnis PM. Biomechanics of sport and exercise. Human Kinetics; 2013.

McPherson, M. (1990). A systematic approach to skill analysis. Sports Science Periodical on Research Technology in Sport, 11(1), 1±10.

Malik SS. Orthopaedic biomechanics made easy. Cambridge University Press; 2015 May 28.

Marc R. Portus & Damian Farrow (2011) Enhancing cricket batting skill: implications for biomechanics and skill acquisition research and practice, Sports Biomechanics, 10:4, 294-305, DOI: 10.1080/14763141.2011.629674

Marshal, R.N. and Elliot B.C. (2005).Guidelines for athlete assessment in New Zealand sport-biomechanical analysis. Science and Medicine in Sport pp.117.

Nicholas Hogg. On beauty: Yes, it matters in cricket. But what is it? The Cricket Monthly

Nigg, B.M. (2003). Sport science in the twenty-first century. Journal of Sports Sciences, 11: 343-347.

Norman, R.W (2009). A barrier to understanding human motion mechanics; Commentary. In: Skinner, J.S. et al. (eds) Future Directions in Exercise and Sports Science Research 151-161. Champaign, III; Human Kinetics.

Portus, Marc & Farrow, Damian. (2011). Enhancing cricket batting skill: Implications for biomechanics and skill acquisition research and practice. Sports biomechanics / International Society of Biomechanics in Sports. 10. 294-305. 10.1080/14763141.2011.629674.

Raza, S., 2016. Relationship of Selected Kinematic Variables With The Performance of Pull Shot Performance in Cricket. *International Journal Of Scientific Research*, [online] 5(3), pp.759-761. Available at: <https://www.worldwidejournals.com/international-journal-of-scientific-research-(IJSR)/fileview.php?val=March_2016_1492757764_230.pdf> [Accessed 25 December 2020].

Sports Biomechanics - IMeasureU | Leading Wearable Sports Sensors. IMeasureU. (2020). Retrieved 23 December 2020, from https://imeasureu.com/knowledge/sports-biomechanics/.

Stretch, Richard & Bartlett, Roger & Davids, Keith. (2001). A review of batting in men's cricket. Journal of sports sciences. 18. 931-49. 10.1080/026404100446748.

Sport. En.wikipedia.org. (2020). Retrieved 17 December 2020, from https://en.wikipedia.org/wiki/Sport.

Wells, K.F. (1966). Kinesiology: The Scienti®c Basis of Human Movement. Philadelphia, PA: W.B. Saunders

Wikipedia contributors. (2020, December 4). Batting (cricket). In *Wikipedia, The Free Encyclopedia*. Retrieved 17:03, December 23, 2020, from https://en.wikipedia.org/w/index.php?title=Batting_(cricket)&oldid=992206037

Wikipedia contributors. (2020, December 20). Cricket. In *Wikipedia, The Free Encyclopedia*. Retrieved 16:07, December 23, 2020, from https://en.wikipedia.org/w/index.php?title=Cricket&oldid=995342156